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AUTHOR Jordan, Miriam M.; Padilla, Michael
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ABSTRACT

This research explores the structure of possible science education reform that can be compatible with structural change in high schools. Financial pressures, increased or decreased enrollment, state mandated changes, block scheduling, and assignments of students to age-appropriate grades are all examples of structural changes. Block scheduling is currently the most popular structuring effort, and the most common form of block scheduling allows four 90-minute classes per day. Need, clarity, complexity, and quality of the program are some of the factors that affect the success of the implemented programs. This paper reports the results of a study that investigates the role of structural changes and Block-8 Schedule on conceptual changes in science education. (Contains 15 references.) (YDS)

The Impact of Block Scheduling on Science Education in a Rural Georgia High School

Miriam M. Jordan
Jasper County High School
1289 College Street
Monticello, Georgia 31064
mjordan@coe.uga.edu

Michael Padilla
College of Education
Aderhold Hall
University of Georgia
Athens, Georgia 30602
mpadilla@coe.uga.edu

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The Context: Restructuring and Reforming Science Education

Despite many years of reform efforts, change has been slow to come to the science classroom. Often innovations fail to deliver the expected results despite sound theory and elaborate planning. There seem to be an inability to successfully and broadly implement the innovation. To do things differently in the classroom, requires conceptual change. This kind of change becomes possible when educators evaluate their current efforts in light of plausible, useful alternatives and embrace an alternative as their preference. However, conceptual change is difficult to implement without an appropriate attendant structural change. The purpose of this research is to explore and document one means by which science education reform may be accommodated by a compatible structural change in the high school. This innovation, block scheduling, can provide the structure within which the

goals of science education reform can be realized. Structurally, block scheduling allows for classes of ninety minutes with students taking fewer classes per day. Conceptually, it can institutionalize numerous practices and strategies that are regarded as essential to the science education reform movement.

The science teaching standards in *National Science Education Standards* (1996), which embody this vision of reform, are grounded in five assumptions:

- The vision of science education described by the *Standards* requires changes throughout the entire system.
- What students learn is greatly influenced by how they are taught.
- The actions of teachers are deeply influenced by their perceptions of science as an enterprise and as a subject to be taught and learned.
- Student understanding is actively constructed through individual and social processes.
- Actions of teachers are deeply influenced by their understanding of and relationships with students.

These assumptions about science teaching call for an examination of what is required to implement these standards. Carl Glickman (1991, p.4) asserts "for too long professionals have gone about the business of teaching and operating schools in ways they privately admit are not in the best interest of students." Reasons abound. There are many pressures including state laws, district policies, local traditions, mandated curriculum, and limited financial resources. Schlechty (1991, p. 69) thinks "that much of what we now do in school probably does not need to be done - and much that should be done cannot be done so long as we keep on doing what we have always done."

Reforming science education requires selecting and stating goals. *The National Science Education Standards* (1996), *Benchmarks for Science Literacy (1993),* and various state-produced documents including the *Georgia Framework for Learning Mathematics and Science* (1995), achieve this step of the change process. However, there must be a plan and a means for implementing these changes. There should also be ongoing evaluation and revision.

Schlechty (1976, p.230) proposes "that the selection of goals indicates what structural changes will need to be made if implementation is to be successful and determines whether the indicated curricular change is indeed an organizational change or simply a substantive reordering within a given structure". In order to achieve the goals of the *Standards* most schools would need to make substantial changes to their present structure.

"One of the reasons so many theoretically sound educational reforms fail 'in practice' is that educators do not recognize the kinds of structural changes that are needed if the reform is to be fully implemented, or if they do recognize them, they are unwilling or unable to make the necessary shifts in the structure. Curricular change, if it is to be more than a reshuffling of existing priorities, is organizational change. Without organizational change, changes in curriculum are more likely illusory than real" (Schlechty, 1976, p.231).

Yet educators have continued as Glickman put it, "to pretend not to know what we know" (1991, p.4). That would explain why so much that is done in the name of curriculum reform - the elucidation of good goals, and the planning of good curriculum, winds up as a hazy mirage of the intended reform.

Indeed, organizational or structural changes in a school are more often pragmatic solutions to problems such as financial pressures, increased or decreased enrollment, state mandated changes or administrative efficiency. These changes often bear little relation to the curricular needs of the school. An historical example of this is the Carnegie unit of credit. The Carnegie Foundation proposed a standard unit to measure high school work based on time. This standardized measure was deemed necessary in order to have a uniform means of comparing the academic progress of students across the country. This rigid structure of the American high school has framed secondary education for almost a century. Today "this bookkeeping device is the basis on which the school day and indeed the entire curriculum is organized" (Boyer in Canady and Rettig, 1995, p.13).

Other examples of this type of structural change include the distribution of about thirty students into one classroom with a single teacher and the assignment of students to age appropriate grades. The former example is related to the fact that this class size approximates the size of the one room school, and the latter example is a convention imported from Prussia as a means of standardization (Schlechty, 1991, p. 65).

Even when a restructuring effort is conceived, planned and implemented for school improvement, the new structure does not automatically translate into improved curriculum or more effective instruction. Fullan (1991, p 201) found that shared decision making in the schools "altered governance procedures but did not affect the teaching-learning core of schools" and further reports the findings of numerous studies done by others that have similar results (1993, p 144). "Schools with shared decision making did not pay more attention to issues of curriculum than traditionally managed schools, and pedagogical issues and

student concerns were low on the list ....for schools" (Weiss in Fullan, 1993, p.145). Fullan (p. 145) concludes that "to restructure is not to reculture". To reculture, short-term and mid- to long-term strategies powerful enough to alter the existing culture of teaching and learning must be found.

One restructuring effort that is currently receiving attention and gaining popularity is block scheduling. This is one structural change that could accommodate the goals of science education reform. Block scheduling proponents and developers, Canady and Rettig (1995, p. xi) see scheduling as far more than the mechanical assignment of students to classes, stating that "Within the school schedule resides power: the power to address problems, the power to facilitate the successful implementation of programs, and the power to make possible the institutionalization of effective instructional practices" .

The most common forms of block scheduling provide four 90 minute classes per day. This study focuses on the alternating day, or Block-8, format which rotates two sets of four courses on alternate days throughout the school year. This format provides the opportunity for teachers to plan extended instruction. Beyond the obvious advantage of being able to conduct the traditional prelab, lab and postlab sequence all in one class period, the block schedule provides the time needed to include alternate models of instruction such as cooperative learning, inquiry, concept attainment, and Socratic seminars. Block scheduling also allows teachers to teach three classes per day and have 90 minutes of planning time. This time is considered essential for planning and designing appropriate instruction. Properly implemented, pairs or groups of teachers can be scheduled for common planning times. In addition, there is time for monthly interdepartmental focus groups of teachers.

As many high schools turn to some form of block scheduling as an expedient means of addressing a variety of issues, undoubtedly some implementations will be more successful than others. Factors that affect implementation of change include need, clarity, complexity, quality and practicality of the program. Each of these should be considered in the planning phase(Fullan, 1991, p. 70-72). Recognizing and addressing these factors within the context of the existing or emerging school culture will increase a school's chances for success. The community, school board, superintendent, school district, principal, teachers, parents, and students must be taken into account first in planning and then throughout the implementation. "Schools with the greatest success in implementing change have a culture of collegiality which supports open communication, trust, support and help, learning on the job, and getting results..." (Fullan, p.77). Where a supportive cultural context does not already exist, its development should precede efforts to restructure and reform the school.

When the vehicle for restructuring the school is block scheduling, development or nurturing of a supportive culture should be the first goal. This process has been described by Canady and Rettig (1995, p.21-22). They believe that it is crucial that all the details of the schedule should be addressed and that all relevant interest groups are made aware of these details. "Most important, however, teachers should be provided time to alter their curriculum appropriately and get training in suitable instructional strategies that will be effective in the block" (p. 22). Continued success of implemented programs is dependent on funding for ongoing inservice, especially for new teachers and administrators coming into the school after the inception of the program. Continued support , enthusiasm, and influence of the principal and others who are seen as leaders are also factors in continued success. Finally, reflective evaluation and input by teachers and students is critical to the refinement and continuation of a successful program.

Purpose of this Study

From a constructivist perspective, this research considers the role of a structural change, the Block-8 Schedule, in supporting the conceptual change inherent in science education reform as delineated in *National Science Education Standards* (1996). The goal of this longitudinal, intrinsic case study is to document the distinguishing features of the Block-8 Schedule, the process of its creation, and its impact on science education in a small, rural high school in central Georgia over a period of four years. It was assumed that the degree to which schedule design and implementation were aligned with a school's environment and population would influence the satisfaction and achievement of the participants, and sustainability of the structural change. This fundamental assumption was investigated. This longitudinal study aims to add substantive information to the few existing research studies on block scheduling in the science classroom and on the ability of block scheduling to support science education reform.

Research Questions

The focusing question of this study is: what are the effects of the implementation of the Block-8 schedule on science instruction, student science achievement, and science classroom environment at Jasper County High School? The following questions guided the research design and data collection.

- What changes in teaching strategies and teaching behaviors have occurred over a period of four years, concurrent with the implementation of the Block-8 schedule?

- What are students' and teachers' perceptions about instruction and changes in instructional strategies that occurred as a result of the Block Schedule?

- How has related systemic support of block scheduling, such as staff development, leadership team efforts, and focus group sessions impacted science instruction?

- What are science teachers' and students' perceptions about the block schedule as it relates to classroom and school environment?

- What are science teachers' perceptions about affective changes in their students?
- How has the Block-8 schedule affected student achievement?

Methodology

This evolving intrinsic case study of block scheduling and its impact on science education in a rural high school placed emphasis on the "sequentiality of happenings in context" (Stake, 1995,p xii) and the holistic nature of the case. It would be inadequate to explicate the changes in science education separate from the encompassing school reform. Data collection has continued on a yearly basis since 1994. In order to give a complete rendering of the events and results of this restructuring effort a mixed method design was developed, applying both qualitative and quantitative methods of data collection and analysis. Triangulation of the data creates a thorough picture of this block scheduling innovation with its implications for science education. This researcher was a fully active participant observer in all stages of the restructuring effort, and in its classroom implementation.

Topics and Sources

Data about instruction, achievement, and climate, which are the topics of the guiding questions in this research, were obtained from three main data sources. These sources were three science teachers, students enrolled in science classes at Jasper County High School between 1994 and 1998, and documentary school records. Justification for attempting to document this innovation broadly comes from the reality that this case study is a unique opportunity to study the impact of alternating day block scheduling from its beginning through its first four years of implementation.

Data Collection

Data collection was accomplished through teacher and student surveys, classroom observations, focus group interviews with students and teachers, and related documents such as lesson plans, and laboratory logs. History of the development of the innovation came from minutes and records of the block schedule task force and from first person accounts. Data relevant to the impact on achievement was obtained from standardized test scores on the Georgia High School Graduation Test. (Although passing this test is required for graduation in Georgia, no validity or reliability is available.) Due to this researcher's position as a participant observer, data from informal events and unanticipated sources were included. This data was assimilated in the qualitative tradition of constant comparison (Glaser and Strauss, 1967).

Interviews : Between 1995 and 1998 a series of interviews was conducted. Focus group interviews were conducted with the three participating teachers to determine teacher attitudes about block scheduling. Questions centered around the impact of inservice, perceptions about student's attitudes, and their own teaching practices, including their use of the 90 minute planning time. During 1998 focus group and individual interviews were conducted with the participating science teachers to follow up on the original interview topics and to ask about changes. These interviews were conducted intermittently with classroom observations. Casual conversations within the department also provided useful data.

Focus group interviews with purposefully sampled groups of students were also conducted. These samples included a college preparatory group of juniors and seniors, a college preparatory group of freshmen and sophomores, a vocational junior and senior group, and a vocational freshman and sophomore group. The aim of this type of maximum variation sampling was to capture and describe central themes and shared outcomes across all groups, as well as to identify outcomes that are unique to particular groups (Patton, 1990). Selection of participants for the four homogeneous groups was made in consultation with their science teachers. The criterion for choosing students was simply to choose students from whom it was believed candid and forthright information could be obtained. The method of data collection for all interviews was by audiotaping followed by transcription. All names used in this paper are pseudonyms.

Classroom observation: The three classes chosen for observation were observed during the ninety minute block sessions on a weekly basis over a period of ten weeks during the spring of 1998. The focus of these observations was guided by the lesson plan submitted for that class session, and each observation served to inform the focus of successive observations.

Documents: Two types of documents related to instruction were available. The participating teachers turned in lesson plans biweekly and lab logs at the end of each six week grading period. The lesson plans require self-reporting of the objective or topic of instruction, the method(s) of instruction, time allotted for each activity, and coding for the Georgia Quality Core Curriculum objectives and for the levels of Bloom's taxonomy addressed by the instruction or activity. Lab logs were kept by teachers as a record of hands-on or laboratory activities in the class. Other documentation came from the leadership team by-laws and minutes, school discipline and attendance records, and Georgia High School Graduation Test results.

Survey Instruments: The Perceptions of Instruction Matrix, a homemade instrument designed specifically for the Block-8 Innovation Project was administered to the school population yearly. It yielded data about the frequency of occurrence of ten specific instructional events in all eight courses. Students indicated the frequency with which these events occurred using three response categories: always, sometimes, and never. Only the data from the science portion of the matrix was considered in this study.

A student attitudinal survey was also designed specifically for this innovation project. The specific nature of the questions as they relate to block scheduling necessitated the construction of this homemade instrument. It consists of 14 items with a

forced choice (yes or no) format. Students responded to items such as whether or not the schedule caused confusion, whether they were becoming better time managers, whether they felt that they had a good year, and whether the liked having four 90 minute classes each day. This survey was not specific to science. Its intent was to capture students' overall impressions and attitudes about the schedule.

The survey was given to all students each year to obtain longitudinal data.

A teacher survey designed for this innovation project was also a forced choice (yes or no) instrument having 12 items. It asked teachers to respond to issues such as discipline, staff development, variety of instructional methods used, and planning time. The construct validity of the instruments was supported by a group of educators whose individual judgments about what the instruments were trying to measure agreed closely with the intended constructs (Henerson, Morris, and Fitz-Gibbon , 1987, p.136).

Analysis

Qualitative methodology: Field notes from classroom observations and data from document sources were coded and analyzed for categories. Interviews were transcribed, coded and analyzed. Development of the coding system evolved through reading and rereading the transcripts, field notes and documents. The practice of memo writing was used as an analysis tool throughout the data collection process. The process of constant comparison and triangulation of data from observations, interviews, surveys and documents was used. As each new set of data was collected, the data was matched against previous sets of data to identify similarities and differences. This process generated coded data. Through focusing and regrouping of the coding, some codes were consolidated, while others were broken down into more specific categories.

Connections between codings generated the findings of this study.

Quantitative methodology : The Perceptions of Instruction Matrix yielded data about the frequency of occurrence of ten specific instructional events. The chi-square goodness of fit test was used to analyze whether or not there has been a significant change ($p < .001$) in the proportion of student responses in each category for each activity from one year to the next. Data from the attitudinal surveys is reported as percentages.

Study Population

Jasper County, located between the metropolitan areas of Atlanta and Macon, remains a rural community of less than10,000. The per capita income is 15% below Georgia's average. The Block-8 schedule affects all students and faculty at Jasper County High School. The enrollment of approximately 500 students , (grades 9-12) reflects the county demographics. Some 54% of these students qualify for free or reduced meals. The racial composition of the student population is 57% white, 42% African American, and less than one 1% Hispanic. The high school is part of a 6th-12th grade campus serving over 900 students. In a larger sense, the project has an impact on all who are involved with the school: administrators, the superintendent, the local board of education, parents, and the community as a whole.

Qualitative Findings

History of the Block-8 schedule: Evolution of the Structure

The history of the Block-8 Schedule parallels the school's implementation of the leadership team model of site based management. This school, a charter member of the League of Professional Schools, has matured in the practice of shared governance. Interdepartmental groups of five to eight teachers, referred to as liaison groups, choose their representative to the leadership team each year. The leadership team elects a secretary and a chairman. The functions of the leadership team were established through bylaws ratified by a two-thirds majority faculty vote. Almost any matter of importance to the faculty, students, and administration, exclusive of personnel matters, may be brought before the biweekly meetings of this group. It was in this climate of school reform that the Block-8 Schedule was born.

In 1992 the leadership team became aware of the newly mandated Georgia graduation requirements for additional units of mathematics and science for non-college preparatory students who would enter high school in or after 1993. While the need to reform mathematics and science instruction for all students has been targeted as a national education goal, at the local level this increase in required courses creates a major logistical problem: scheduling these students into their extra science and math courses within the confines of a six period school day. The leadership team identified problems attendant to this requirement increase, including the deletion of some sections of science electives, or placing some teachers on extended day contracts in order to create enough sections of the courses. An extended day contract translates into no planning period during the regular school day. The teacher is supposed to use the hour immediately after school each day as the planning period. In reality the science teachers were already averaging much more than a hour after school each day to plan, meet with students, direct projects, work with competition teams and meet with various committees.

A task force was appointed by the leadership team to research and develop a scheduling plan to address this problem. The result of that effort has come to be known as the Block-8 Schedule. The plan was designed to increase scheduling flexibility and to provide for increased science and mathematics instruction. The initial step was to establish criteria against which any proposed plan would be judged. These criteria included 1, increased time slots in the schedule; 2, increased planning time for teachers; 3, time for teachers to co-plan; 4, increased opportunities for integrating curriculum; 5, maintenance of class size at the current

level; 6, support for inclusion of effective teaching practices; and 7, the pragmatic necessity of meshing with the system-wide bus schedule and schedules of shared system personnel. Several possible schedules were researched and subsequently rejected when each failed to meet the established criteria or failed to gain the support of the faculty.

In 1993, the task force began to explore a radical restructuring of school time. Looking at school time as a resource, the task force thought of the schedule as merely the framework within which to accomplish the important educational goals addressed in the original criteria.

The Block-8 schedule was conceived in October 1993 after a brief article in *NEA Today*

(1993), was brought to the attention of the group along with the question "how would you all like to teach three periods a day and have ninety minutes of planning?" Initially the group was skeptical. Most were sure there was no way the numbers would work out. However, the lure of 90 minutes of planning caused several members of the task force to meet with the counselor to investigate the numbers. Examination of the numbers and model calculations that allowed for growth in enrollment indicated that the school would be able to accommodate a four period day.

At that point, enthusiasm and concerns both grew. Teachers discussed the advantages and disadvantages both in liaison groups and informally in conversations among themselves. The rest of the 1993-1994 school year was spent studying and refining the plan to eliminate anticipated problems. A major decision was to design an alternating day schedule with eight courses across the year rather than four courses per semester with different courses each semester. Once the task force committed to developing the alternating day plan, a prototype schedule was constructed that allowed appropriate pairs of teachers to have common planning times to facilitate integration of their curricula. The final schedule was developed from the prototype as issues of coordination and scheduling were resolved.

The schedule plan was for class periods one through four (1-4) to meet on Mondays and Wednesdays, and periods five through eight(5-8) to meet on Tuesdays and Thursdays, with periods 1-4 and 5-8 swapped on alternate Fridays. This unique feature of the Block-8 schedule was conceived as a pragmatic way of accommodating itinerant system personnel. This arrangement also has the advantage of consistency. The only day of the week that the schedule ever varies is Friday. If school is ever closed due to inclement weather, everyone still knows which set of classes they will return to when school reopens. The task force had found that schools on a continuous alternating schedule had some confusion upon the return to school after a snow day.

During the 1993-1994 school year and the following summer, inservice involved the majority of faculty members in focusing on integration of curriculum. Teachers from different departments were paired together to write interdisciplinary lesson plans or units. Inservice

based on higher order thinking skills (HOTS) and the Georgia Critical Thinking Skills materials was offered to teachers in sessions spaced throughout the year.

Teachers were informed as to the progress of the planning through leadership team and faculty meetings. The final version of the plan was presented to liaison groups in April, 1994. Teachers' questions and concerns were aired during these liaison group meetings. Teachers then voted by a margin of 29 to 4 to adopt the block-8 schedule. The schedule was explained to students during the process of registration for the upcoming year. Letters were sent to parents and a parent meeting was held. Parents, teachers and students were surveyed about their expectations and attitudes toward the schedule in order to establish baseline data in anticipation of comparative data to be collected at yearly intervals after implementation of the schedule. In addition, the proposed schedule was taken to the local board of education for their final approval and permission to pursue two waivers of state standards, required to implement the schedule. During this same time the task force was working closely with the Georgia Department of Education to prepare the necessary waiver proposals. The first proposal was to waive the standard definition of a Carnage Unit from 150 to 135 clock hours, and the second was to waive the standard method of taking the FTE (full time equivalent funding formula) Count twice a year. The rationale to support these waivers was successfully defended by the task force to the Georgia Department of Education and the waivers were officially granted by the Georgia Board of Education in July, 1994. Once the waivers were official, students were scheduled into the eight blocks for the 1994-95 school year.

The first year of the implementation moved along smoothly. Students knew where to go and which set of classes to attend with little confusion. Teachers adjusted almost as quickly as the students. Teachers experimented with various teaching techniques and lesson formats. Most teachers reported feeling less stress than in previous years, after an initial period of adjustment to the schedule. However, teachers did indicate that although they knew and tried numerous teaching strategies, they wanted more inservice. Concurrently, the task force submitted a grant proposal to the Georgia Department of Education (DOE) School Innovation Program. The grant was funded, which enabled the task force to send one member, this author, to the University of Virginia for training in organizing instruction in the extended block class. This teacher then worked with another task force member to develop and lead a two day inservice, Effective Teaching in the Block, for faculty members. The purpose of the training was to enable teachers to organize various teaching strategies into effective 90 minute lessons. During the 1995-1996 school year, science teachers who had taken this inservice wrote units that incorporated the targeted teaching practices. The units were prepared for two purposes. First, in producing the units teachers spent a great deal of time considering the possibilities for their own classes' instruction. Second, the units were meant to be models for other teachers.

The Block-8 Schedule was validated for dissemination to other schools by the Georgia DOE Innovation Program . Any Georgia high school could then apply for adoption funds and inservice support to implement this model of block scheduling. The training process and materials were developed by the task force and faculty at Jasper County High.

Through this process the entire school moved from the traditional high school structure to a new extended block schedule model. The teachers did most of the planning with strong support from the building level administrator and the blessing of the central staff. The process was spread over almost three years with inservice support. A structure and climate were created that seemed capable of supporting science education reform.

Science Teacher Participant Data

Hadid is a middle-aged male who had taught for fifteen years when this study began. He is originally from the Middle East. He exhibits confidence as a teacher, but has not participated in most of the inservice aimed at instruction in extended blocks of time. His teaching assignment has changed each year and for two years he was on an extended day contract. He teaches some classes outside the science department.

Beth is a young White female teacher who had five years teaching experience at the beginning of this study. That year was her first year teaching in this school and her first experience with extended class time. At that time she had had little exposure to the concept of extended class time. However, she did participate in Effective Teaching in the Block inservice and has completed her specialist degree during the course of this research.

Raymond is a young African American male who was in his second year of teaching when this study began.. He participated eagerly in the inservice offered. He was trained in the use of the CORD Applied Biology and Chemistry curriculum, participated is a cooperative learning workshop, the Effective Teaching in the Block inservice, and the Critical Thinking Skills inservice. He has expressed a desire to take the concepts from the inservice course and use them in his classes.

There are only four teachers in the science department including this researcher. While this limited the number of participants, it still provided a range of perspectives, due to the differences in age, race, ethnicity, teaching experience and inservice experiences. All these teachers hold advanced degrees in education with emphasis in the sciences. In addition, these teachers share a suite of three science class/lab rooms with common storage areas. They are in constant contact with each other and consult with each other frequently. There is a feeling of collegiality within the group.

Findings on science teaching strategies

The focus group interview was a rich source of data. The participants, having various backgrounds, had different slants on the issues involved in block scheduling and 90 minute alternate day classes. All three teachers revealed in their statements that the longer class blocks had affected the variety and types of teaching techniques used in their classes. A typical teacher comment was Hadid's assertion about a research / debate activity his physics class did that fit well in the 90 minute block: "We had time [to do the activity]. If we didn't have the ninety minutes there's no way we could have done it."

Beth related that earlier on the day of the interview, she had taken her class to the athletic track to conduct a physical science lab and still had time to return to the classroom to complete the calculations and explanation. The schedule also facilitated her rocketry unit which culminated in an outdoor launch day. She reported that her classes were doing more group work than in previous years. However, she did not think that her methods had changed very much although she was "doing more of everything".

Raymond commented that within one class period "there is time to introduce a topic with a hook, give a short lecture, assign and complete a group activity, do a closure activity and still have time to assign and explain homework ." Hadid summed up the change by saying that with 55 minutes classes the teacher had to select activities that could be completed in 20 or30 minutes. In a ninety minute class the activity might take an hour to complete, but there is still time to properly introduce the activity and have time for students to develop better understanding.

Impact of Inservice on Science Teaching

Over the past three years inservice for this high school has focused on effective teaching strategies that have included integrating curriculum, cooperative learning, HOTS (higher order thinking skills), CTS (critical thinking skills), and Effective Teaching in the Block. Discussion revealed examples of how concepts from the inservice have been incorporated into teachers' instructional repertoire. Round Robins or "stations" were a favorite of Raymond's. He gave examples of a unit on AIDS and one on the environment that he had organized for round robin instruction. Students were given 15 to 20 minutes per station. Stations typically included a computer activity, a science process station, and a reading station. Another unit this teacher has developed is a sophisticated cooperative learning strategy that involves structuring the entire class into a "workplace". The class was the corporation and made board decisions about job placement. Every student received a specific job description within the work groups (cooperative groups). Then the class ran itself based on this organization with the teacher serving as a consultant to the group.

A practical application from the Effective Teaching workshop that two teachers mentioned was the use of the dry erase boards. Beth uses them for organizing class assignments like a bulletin board The teachers also use small squares of dry erase board as slates for cooperative groups where each participant writes with a different color marker to distinguish his responses from others in the group. These were thought to be especially effective tools for a silent roundtable activity where the question has multiple answers.

Statements that revealed attempts at integrating curriculum and working with teachers from other departments included Raymond's report of collaborating with the psychology teacher when both classes were studying the brain. He also integrated his anatomy course with the Certified Nurses Assistant class. Several students are in both classes and he and the health occupations teacher tried some co-teaching of the two classes.

Hadid indicated efforts at integrating physics and trigonometry. He and the trigonometry teacher worked together early in the school year to teach trigonometry and vector problems in relation to one another. He also stated that he has shared materials about physics and civil war weaponry with the social studies department.

According to these teachers there is more opportunity for incorporating a variety of teaching strategies and activities into instruction on the block. They referred to examples that came from inservice. Analysis of their comments reveals a noticeable difference in the types and variety mentioned from teacher to teacher. The more inservice teachers had taken, the longer, more numerous, and more specific their accounts of implementing strategies were. This is not an unexpected finding, but it certainly has implications for the role of inservice in the effective implementation of block scheduling and science education reform.

Analysis of lesson plans from these teachers supports this same conclusion. The teachers who had more inservice provided lesson plans that showed more evidence of organizing the lesson for effective teaching. However, all the written plans reflect the use of multiple strategies and variety. In all but one set of plans, the time allotted for each activity is also noted. The plans are coded for critical thinking skills, and the levels of Bloom's taxonomy. In some cases effective teaching practices are noted. This coding is done as the lesson plans are prepared, so there is no way to ascertain that the events described on paper always occurred in the classroom. Indeed, in some cases it appears that the coding may be an over-zealous attempt to impress or satisfy the administrator who reads the plans.

Even so, there is an obvious awareness among these teachers that a variety of activities at various cognitive levels is important to providing effective instruction. As lesson plans are prepared the teacher must decide which activities and strategies will work and commit these to written plans. In a preponderance of lessons the teachers planned for at least three activities. Furthermore, the plans generally reflect, and are coded for, multiple cognitive levels and several critical thinking skills and /or effective teaching practices each week.

Indications that inservice had an impact on planning are evidenced by two negative examples. During the second year of this study, Beth, who has not had the critical thinking skills training, frequently listed numerous critical thinking skills codes for a single lesson. It would seem impossible to handle all of the listed critical thinking skill activities during that one class. This is most probably a case of mistaken identity. The teacher called the activities critical thinking skills when in reality they are routine discussion, question and answer, or other traditional classroom events.

A second example was Hadid's lesson plans during the second year in which no times are given. With ninety minute blocks effective use of time is critical to effective instruction. The Effective Teaching in the Block inservice stressed time management and smooth transitions between activities. Times listed in lesson plans should be rough approximations to be used by the teacher for time management. The lack of these approximations coupled with the fact that these same plans are very brief and lack description indicates less effective lesson planning. Hadid did not take the Effective Teaching in the Block inservice and did not have a ninety minute planning time during the regular school day due to his extended day contract. This apparently made effective lesson planning much harder. The other two teachers had this inservice and had ninety minutes of planning daily. These problems were not evident in the plans they prepared.

When year four lesson plans were coded and analyzed, the problems noted in year two plans were no longer found. Although all three teachers wrote less detailed plans than they had in previous years they continued to code activities consistently.

Findings on teacher use of planning time

The task force planners anticipated that ninety minutes of planning time would allow teachers time to plan better instruction. Teachers responded favorably to this assumption. The consensus was that the ninety minutes allows more time to get the work of teaching done. Especially important to the teachers was the fact that there is more time to set up and take down labs. Beth mentioned that having some time for reflecting on her lesson plans was very important to her. Her lesson plans reflect this thoughtfulness about her teaching. From teacher comments it appears that they are applying higher levels of Bloom's Taxonomy to their own planning.

Although Beth and Raymond share their rooms during their planning time on alternate days, neither teacher noted this as a problem. There is a large comfortable planning area very near the science department which has computer hookup, telephone, copying machine, restroom, and snack machines. Both teachers mentioned using this facility for some of their planning time. The amenities and proximity of this area make leaving their own rooms more palatable.

I have observed Beth using this room and its computer almost daily and she is very efficient. She is able to concentrate even when other colleagues carry on the banter typical of such a room. In addition, since she and I and a special education teacher who works with us share a common planning period we meet in this room to plan together. This coordinated planning time was purposefully built into the schedule. Beth and I talk about departmental matters such as ordering materials, labs, instructional ideas. Beth talks with the special education teacher about how they will carry out activities in the class, how they will divide the responsibilities for instruction and evaluation, and issues about particular students. They discuss students who are causing problems or who are having problems.

Hadid was an extended day employee during two years of this research. Planning time for extended day employees is supposed to occur after regular school hours. This teacher was vague about how and when he planned during the years when he was on extended day contract. His comments reflected that for him, planning time was "hit or miss". One of the most important components of the Block-8 Schedule is the extended planning time and the opportunity to co-plan with other teachers. This teacher did not get the benefits of this aspect of the schedule. Weaknesses noted in his lesson plans associated with lack of inservice were discussed in the previous section. However, lack of planning time is an equally important factor. Schools considering adopting the Block-8 Schedule should fully consider the impact of extended day contracts on the benefits of the schedule before staffing teaching positions with extended day employees.

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Findings on science teacher attitudes and perceptions

Teachers' comments indicate positive attitudes and perceptions about the Block-8 Schedule and classroom climate. The focus group interview yielded phrases interspersed in the dialog that indicated the degree of teachers' satisfaction with the schedule. Comment included: "We did good..."; "I am satisfied..."; " You can be more human in 90 minutes."; " It's not just rush, rush, rush."; " I don't want to go back to the old schedule", " I'm more relaxed"; " I was more relaxed after I adjusted."; and " I was real nervous about it but it was a lot easier than I thought it would be... this was my first year so it was harder for me at the beginning of the year."

To summarize these comments, Beth felt some anxiety about teaching 90 minute classes and thought that at the beginning of the year it had been harder for her, but it was easier than she had anticipated. She also commented that she and her students had more fun together and she liked seeing different groups of students on alternate days. The other teachers expressed a high degree of personal satisfaction with the schedule.

Teachers also perceived positive effects of the schedule for the students. An increase in student responsibility was mentioned as a result of cooperative learning activities and workplace related activities. There was a split in opinions about the degree to which assignments are being completed. This interviewer has seen students accept more responsibility for assignments and make-up work, while Beth reported the reverse situation in her classes. She stated that she had seen a decrease of homework from her vocational level students. This statement was based on her comparison to the school where she previously taught. She also noted that she was making some organizational adjustments to try to change this trend. She has begun to employ the dry erase board as an assignment bulletin board.

All three teachers also noted a more relaxed attitude among the students and an apparent reduction in stress. The perception was that having two days between classes allowed for more time to prepare for their harder classes.

Hadid expressed concern about "lower level" students who are frequently absent. His perception was that they are not helped by the block schedule. This teacher also had reservations about these students missing lectures which he perceived as a very important part of his teaching. This teacher did not participate in the Effective Teaching in the Block inservice which stressed the use of multiple teaching strategies and lesson closure. This teacher's concern stems from the schedule arrangement. Each class meets three times one week and twice the following week. Frequent absences might translate into a student being present for only one class a week. Absenteeism is, and has been, a documented problem in the school. It was a problem on the old schedule and it is still a concern on the new schedule. However, the number of absenteeism hearings dropped during the first year of block schedule implementation. Therefore, the schedule may be having a positive impact on attendance. If a student is out one day he has missed four 90 minute classes, but he has not missed his other four classes. Whereas on the old schedule, he would be missing all six of his 50 minute classes.

Findings from Other Related Documents

Based on documentary evidence of the Block-8 Schedule Innovation Program, science reform is being supported in the following ways. Teachers have only three classes per day, compared to the previous five classes per day. Teachers also have 90 minutes of planning time compared to the previous 55 minutes. Discipline referrals decreased greatly during the first two years of the innovation and then leveled off. Self reported lab logs indicated that the teachers increased the time spent doing hands-on activities. Data from the Georgia High School Graduation Test shows an increase in the number of students passing this test on the first try. During the year before the implementation of block scheduling, 50% passed. That percentage has risen over the past four years to 65% in 1998.

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Quantitative Findings

Statistical Analysis of Survey Data

Chi-square Goodness of Fit : Yearly data for science courses taken from the Perceptions of Instruction Matrix were analyzed using the chi-square goodness-of- fit test. Due to the nominal nature of the survey responses and the need for a statistical method that would allow comparison of distributions from one year to the next, this test was an appropriate means of data analysis (Weinberg and Goldberg). A two by three design was used, comparing the distribution of students' responses, "often", "sometimes" or "never" for year one (1995) of the study to responses for year two (1996) to determine the goodness-of- fit between the two distributions, with year one (1995) data being considered the expected values. Then data for year two (1996) became the expected values with year three (1997) data being compared back to it. Continuing this process, year three data (1997) became the expected distribution against which year four data (1998) was tested for goodness-of-fit. Ten separate items were analyzed in this manner. The choice of level of significance, p=.001 is conservative and reflects a high level of concern for Type I error. This level was chosen because this researcher has been highly involved with all stages of the block scheduling process and felt it necessary to set a more stringent level for determining whether there was a significant change. This was done to offset any possible researcher bias. Chi-square values are presented in Table One.

Year One Findings: The Perceptions of Instruction Matrix collects data on the frequency (often, sometimes, never) of targeted instructional issues. Survey statements were: 1. Ninety minutes helped me in this class.; 2. We worked in groups; 3. We did projects; 4. We did library research; 5. We worked together to answer questions, solve a problem or a mystery; 6. We did hands-on activities or labs; 7. We had homework; 8. We did two or three different activities during a class; 9. Ninety minutes goes by quickly; 10. Lecture is not the main activity. The results of the chi-square analysis for goodness-of-fit between the students' responses at the end of the first year and at the end of the second year showed a very marked difference. For all but two items (3 and 10), statistical significance at the p= .001 level was found. These chi-square values ranged from 21.86 to 226.796, indicating a lack of goodness-of- fit between the distributions. This significant change in the pattern of students' responses indicates that something changed between the end of the first year and the end of the second year. Teacher experience might be a contributing factor. However, the dramatic shift coincides with an intervention which was intended to affect the delivery of instruction. This intervention that occurred during the summer between these two years was the Effective Teaching in the Block inservice.

Triangulation of data : Data from teacher interviews support this assertion. The teachers mentioned numerous examples of teaching strategies they had incorporated and activities they had developed as a result of the inservice. Student interviews and classroom

observation also support this explanation. Students described cooperative group activities, projects and hands-on activities, although they also said they wished they had more of those kinds of experiences in class. Classroom observations yielded a similar analysis. There were creative and effective teaching activities taking place during most of the observations. However, there were observations of very structured, traditional classes as well. There were also some observations when no organized teaching or activity occurred.

Findings from subsequent years: While year one and year two data revealed a great deal of change, data for the third (1997) and fourth(1998) years remained very stable with no significant differences (except for items 3 and 10). There is a good fit between the data for these years. The gains that occurred during the second year(1996) were reflected in the lack of goodness-of-fit of that data to the prior year (1995). Then the 1997 data closely matched the 1996 data, indicating that the improvements that occurred the previous year were sustained. Further analysis showed that the 1998 data had a good fit to the 1997 data, indicating that the improvements were durable over the three year period.

The items that showed a significant difference in their distributions between year two (1996) and year three(1997), we did projects, and lecture was not the main activity, then showed the stabilized goodness-of-fit for year four (1998) compared to year three (1997).

Themes that Emerged from the Data

Structural change supports the cultural change.

One theme that emerged from the focus group interviews, class observations, and surveys

was that there is overall satisfaction with the block schedule. Data supports the idea that the block schedule is a good fit for this school. Attitudinal data from both students and teachers indicate a high level of satisfaction both in the science department and throughout the school. This level has been fairly consistent over the four years, ranging from 85% to95% of the respondents giving favorable responses. Students and teachers feel comfortable with it and like their classes. Teachers reported a more relaxed attitude among themselves and less observed stress among their students. There was some evidence that the level of student responsibility had increased, presumably because the alternating day schedule required more organizing on their part. Neither teachers nor students want to return to a traditional schedule.

Inservice supports altering instruction.

A second theme involves changes in instruction related to inservice training. Teachers were very aware of the need to plan lessons that incorporated critical thinking skills, effective teaching practices, and integrated curriculum. During the interviews many examples of their efforts were reported and this was supported by the class-room observations. The degree to which these appear correctly coded in lesson plans and are actually employed seems to be related to the amount and types of inservice the individual teachers have had. However, analysis of survey data across all subject areas, revealed that students' perceptions

on teachers' use of varied instruction and teachers' perceptions of the same item were originally widely separated. For example, during the second year, 50% of the students indicated that their teachers used more teaching methods than they had last year, while 81% of the teachers felt that they had used more variety in their classes. However, during the following years, this gap narrowed. While the student percentage continued to hover around 50%, by 1998 the teachers' response percentage on the issue of using more teaching methods had dropped to 67%. This data is consistent with interview and observation data that teachers made more changes during the first and second year, and may be sustaining those changes but made fewer changes in the following years. At the same time at least 50% of the students felt their teachers were using different activities or methods. This may be due to the students moving from one teacher to another each year, thereby experiencing the different teacher's teaching methods.

Implications_

Implications for Local Implementation of Block Scheduling

These findings have implications for Jasper County High School as its project director and leadership team continue to refine the Block-8 Project and for other schools who consider its adoption. First, a climate of support and collegiality must be established. Second, it seems extremely important that inservice be available to teachers who are going to teach in extended blocks of time. Therefore this training should be available for new teachers coming into the school as well as for other teachers who might not have already had the appropriate inservice.

Third, ninety minutes of planning time is essential to the success of the restructuring. Further, this planning time is more productive if it is coordinated to allow coplanning with other teachers and if a comfortable, well equipped place is provided for this planning. Fourth, the hiring of extended day personnel does not fit the goals of the Block-8 Schedule. The use of this staffing should be avoided to the extent possible. Since these teachers teach one extra class they miss out on the planning times with other teachers.

The block schedule can not guarantee that science teaching and classrooms will change, but it does provide a framework within which the goals of science reform can take root and be nurtured. All three teachers increased their repertoire of teaching strategies during the first two years of the innovation program when program support and emphasis was evident. However, classroom observation during the fourth year revealed that the extended time was not consistently productive in one classroom. Therefore, the final implication is that there is a need for continued system support and inservice to sustain and encourage the changes in classrooms and instruction.

Implications for Structural Change Supporting Conceptual Change

On the one hand, we have the conceptual standards for science teaching as presented in the *National Science Education Standards* (*NSES*) , and on the other hand, we have the structural change provided through block scheduling. This structure can support the assumptions of the standards for science teaching.

Assumption one is that "the vision of science education described by the standards requires changes throughout the entire system"(1996,p.28). The explanation given for this includes the ideas that teachers must be provided with resources, time and opportunities to make changes described in the program and system standards of the *NSES* . The Block-8 Schedule was conceived, developed and implemented by the teachers in the school. It provided the time and relevant inservice to the teachers. When the system changes to provide ninety minute classes in a block schedule teachers gain time for teaching in ways that support the NSES program standards.

The second assumption is that "what students learn is greatly influenced by how

they are taught"(p28). Teachers are expected to make decisions about content, activities, and evaluation. The instructional options open to teachers are greater when the teacher can work with the students for a longer block of time. These curricular decisions all impact the interaction of students with the curriculum and therefore deeply affect what and how students learn and how they perceive science.

The third assumption is that "the actions of teachers are deeply influenced by their perceptions of science as an enterprise"(p.28). While block scheduling can not directly influence the teacher's perceptions of science, it does provide blocked planning time each day for teachers. The traditional planning period is 50 to 55 minutes. For a teacher teaching five classes per day, this equals 10 or 11 minutes of planning time per section taught. In a block schedule setting, the teacher has 90 minutes of planning time to prepare for teaching three sections per day - the equivalent of 30 minutes per section. This is a threefold increase in planning time. While it could certainly be argued that this is still too little planning time, it does allow teachers more time than they have traditionally had. This additional time can facilitate teacher reflection. Teachers can use this time to reflect on their curriculum, their teaching, and their students.

The fourth assumption, "student understanding is actively constructed through individual and social processes"(p.28), goes to the heart of the *Standard's* vision of how the process of learning should occur. This assumption espouses constructivism and inquiry as the way scientists work and therefore as the way science should be done in the classroom. In classroom practice it takes more sustained time for the student to construct his own knowledge and then to link it to other learning. Working and communicating with others is not a linear process. The convolutions of interaction that engage the student and promote learning lack assembly line efficiency. This type of learning is difficult for the teacher to promote in 50 minute classes. Traditionally

teachers have resorted to more time-efficient, though less effective, methods of instruction. Again, the longer class block provides the opportunity to employ cooperative instructional methods and an inquiry approach to learning. Although it is beyond the scope of this paper, classroom observations collected during this research support the ability of block scheduling to facilitate inquiry and construction of knowledge.

The fifth assumption, "actions of teachers are deeply influenced by their understanding of and relationships with students" (p.28) , refers to the need for teachers to build strong relationships with students. In today's high schools which are characterized by more diversity than ever before, this is not an easy task. In the traditional class period, there is little time for the kind of interaction that helps the teacher to understand the students in more than a superficial way. The quiet, the slow, the misfit, may never get the attention they deserve. Furthermore, in Georgia on the traditional schedule, a science teacher may see as many as 120 students per day, based on the Georgia Quality Based Education (QBE) Act. In the blocked format, the science

teacher would see no more than 75 students per day, using the same QBE guidelines. Seeing fewer students per day but having them in class for ninety minutes, and engaging with them in learning activities influence teacher's perceptions of the students. The *Standards* is committed to the belief that all students can learn science. The block schedule provides the opportunity for the teacher to learn about the students, so the students can learn science.

Table 1: Chi -square Values for Goodness-of-Fit Test

INSTRUCTION ISSUE	chi-square goodness of fit: 1995-1996	chi-square goodness of fit: 1996-1997	chi-square goodness of fit: 1997-1998
critical chi-square= 13.816; df = 2 p = .001			
1. Ninety minutes helped me in this class.	* 38.78	0.69	4.45
2. We worked in groups.	* 226.79	5.43	10.37
3. We did projects.	5.34	* 74.23	7.52
4. We did library research.	* 21.85	11.69	7.91
5. We worked together to answer questions, solve a problem or mystery.	* 112.03	5.08	3.14
6. We did hands-on activities or labs.	* 103.55	0.39	4.88
7. We had homework.	* 169.41	2.14	9.34
8. We do two or three different activities during a class.	* 74.51	8.76	5.59
9. Ninety minutes goes by quickly.	* 42.54	10.18	6.97
10. Lecture is not the main activity.	11.00	* 16.99	2.63

* = significant chi-square values

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